

Open Source Lessons Learned with Open MCT

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Silicon Valley

Open Source CubeSat Workshop 2018



The Vision

- Closed —> Open
- Ground systems have traditionally been built on proprietary systems.
 - Duplication of effort - we continually re-create the same thing
- Let's move to a shared model for ground systems and build on each others work
- The internet economy as an analogy - companies may focus on their core differentiators and use existing infrastructure



Immediate Benefits

- Collaboration that works
- Use, adopt, make it your own, contribute
- No ownership issues
- Instant access
- Fork/Pull

A web based mission control framework. <https://nasa.github.io/openmct/>

🔖 5,339 commits	🌿 247 branches	📦 23 releases	👤 38 contributors
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Branch: master ▾ New pull request Find file Clone or download ▾

👤 charlesh88 and psarram [Frontend] Adds overflow scrolling to .l-view-section (#2039) ... Latest commit e19ce4a 5 days ago

📁 docs	[Documentation] Add security guide (#1900)	4 months ago
📁 example	Handle string states (#2019)	21 days ago
📁 platform	[Frontend] Adds overflow scrolling to .l-view-section (#2039)	5 days ago
📁 scripts	[Copyright] Update copyright year across platform code references	9 days ago
📁 src	[Copyright] Update copyright year across platform code references	9 days ago
📄 .gitignore	Add functionality to allow users to add hideParameters to the url, wh...	9 months ago
📄 .jscsrc	[Code Style] Add JSHint rules	2 years ago
📄 .jshintrc	Disabled late definition check for functions	4 months ago
📄 .npmignore	[Build] Add npmignore to allow packing	2 years ago
📄 API.md	Summary widget telemetry provider (#1943)	a month ago
📄 CONTRIBUTING.md	[Documentation] Edit for style	a year ago
📄 LICENSES.md	Include 2017 in copyright #1517	a year ago
📄 Procfile	Merging in latest github/master	3 years ago
📄 README.md	prepare -> prepublish	5 months ago
📄 app.js	Revert "[proxyUrl] pass URL parameters to proxied URL"	2 years ago
📄 bower.json	Lock filesaver version (#1956)	2 months ago
📄 build-docs.sh	[Licenses] Update copyright year to 2017	a year ago
📄 circle.yml	Bump Node Version	23 days ago
📄 gulpfile.js	adds v8-compile-cache	5 months ago
📄 index.html	[Autoflow] Rewrite Autoflow Tabular using new APIs (#1816)	6 months ago
📄 jsdoc.json	Squashed commit of the following:	2 years ago
📄 karma.conf.js	[Plugin] Add imported root plugin (#1784)	3 months ago
📄 openmct.js	new-plot import (#1557)	3 months ago
📄 package.json	Enterprise-galactica (#1993)	a month ago
📄 test-main.js	d3 selection filepath changed (#1898)	4 months ago

<https://github.com/nasa/openmct>

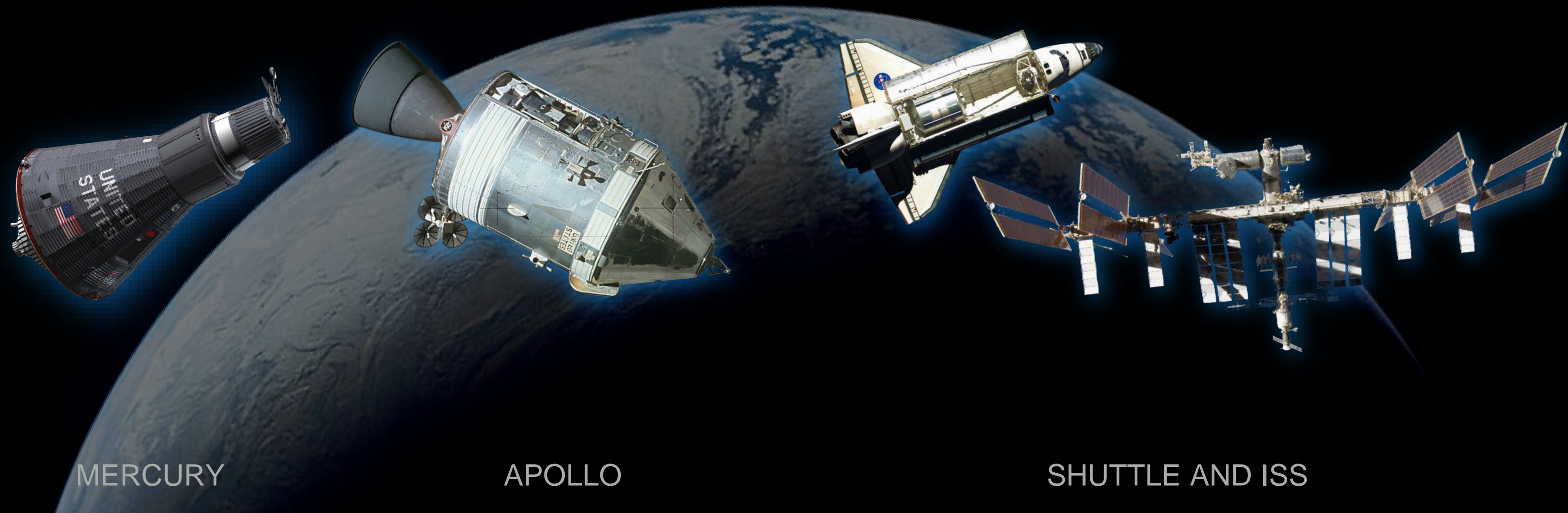


More benefits

- Better software
 - More eyes on your software
 - More users
 - A community that drives you to be better
- Yes, missions do some of this, but the environment is somewhat insular so there are benefits to a broader group of users and contributors



How have we advanced since the 1960's?



MERCURY

APOLLO

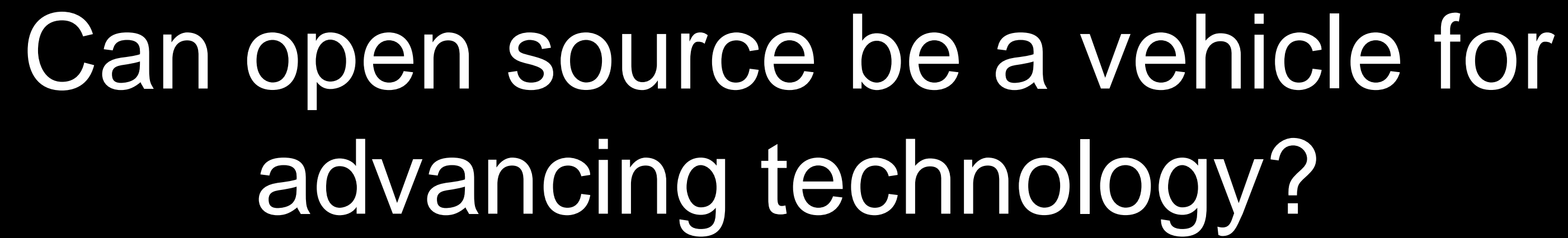
SHUTTLE AND ISS



1960's



2000 and beyond





The platform

- Open Mission Control Technologies - Open MCT

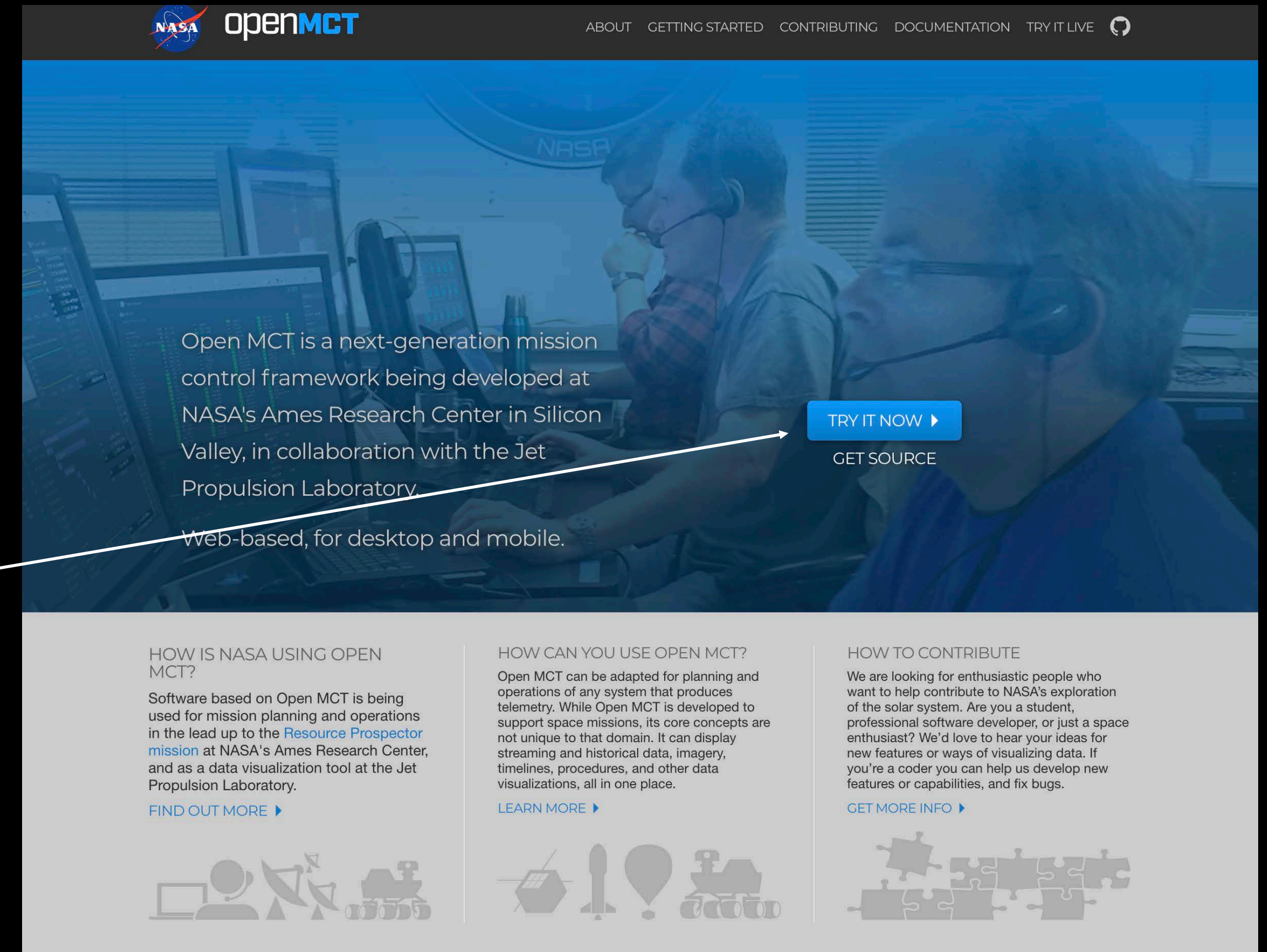
- Info

- <https://nasa.github.io/openmct/>

- From info site, click on Try it Now

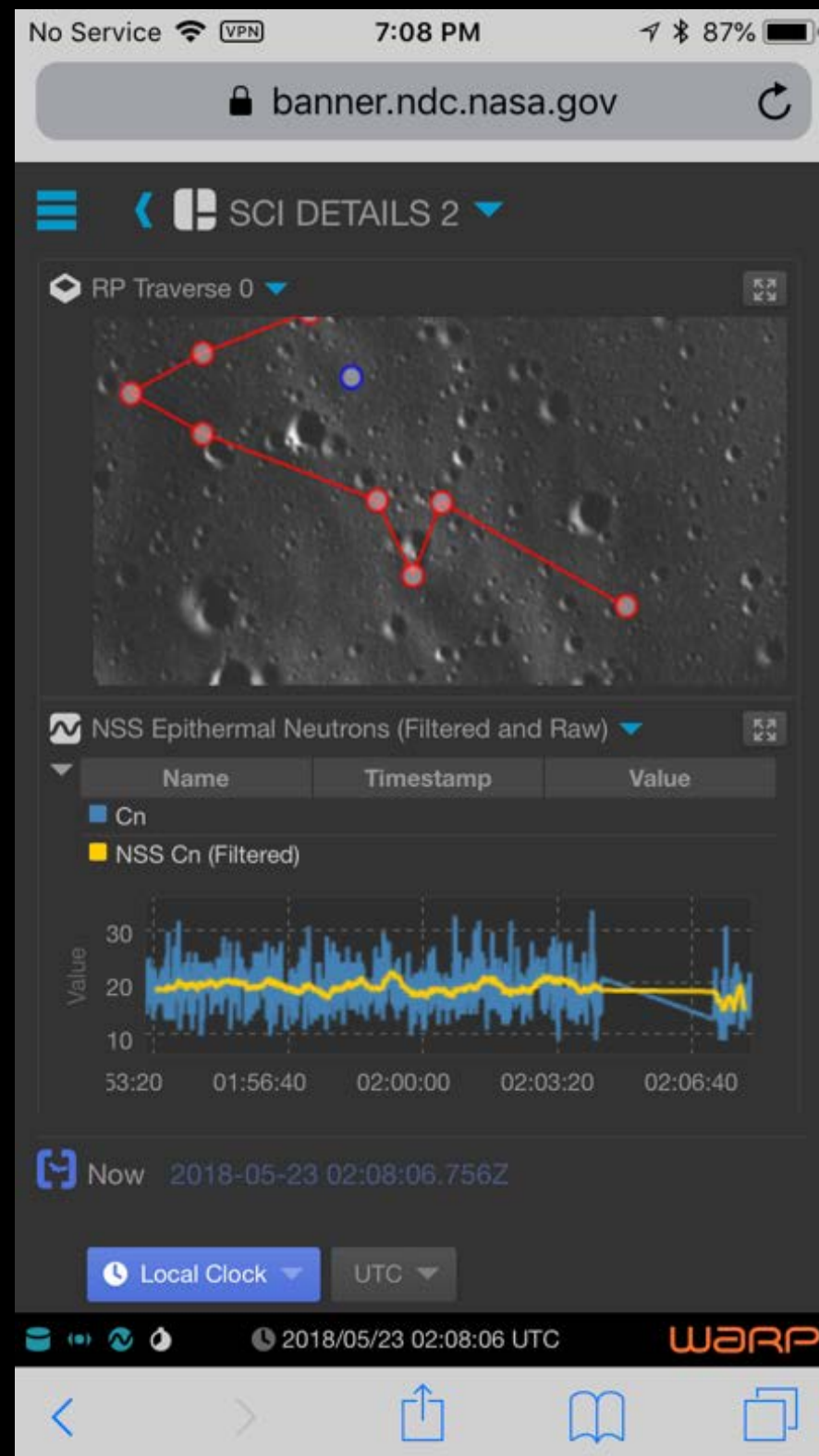
- Code

- <https://nasa.github.io/openmct/>

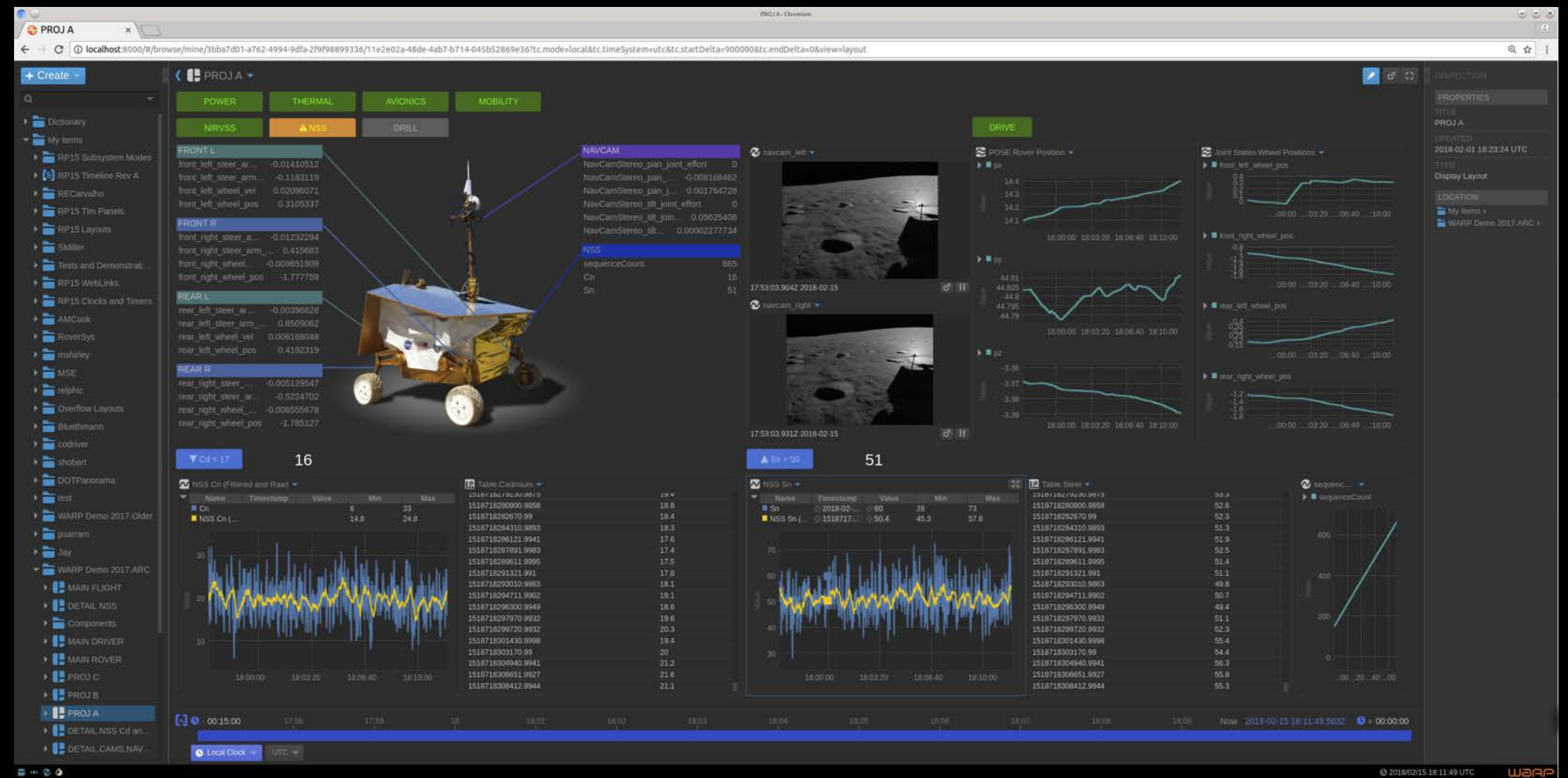




The Platform



Mobile

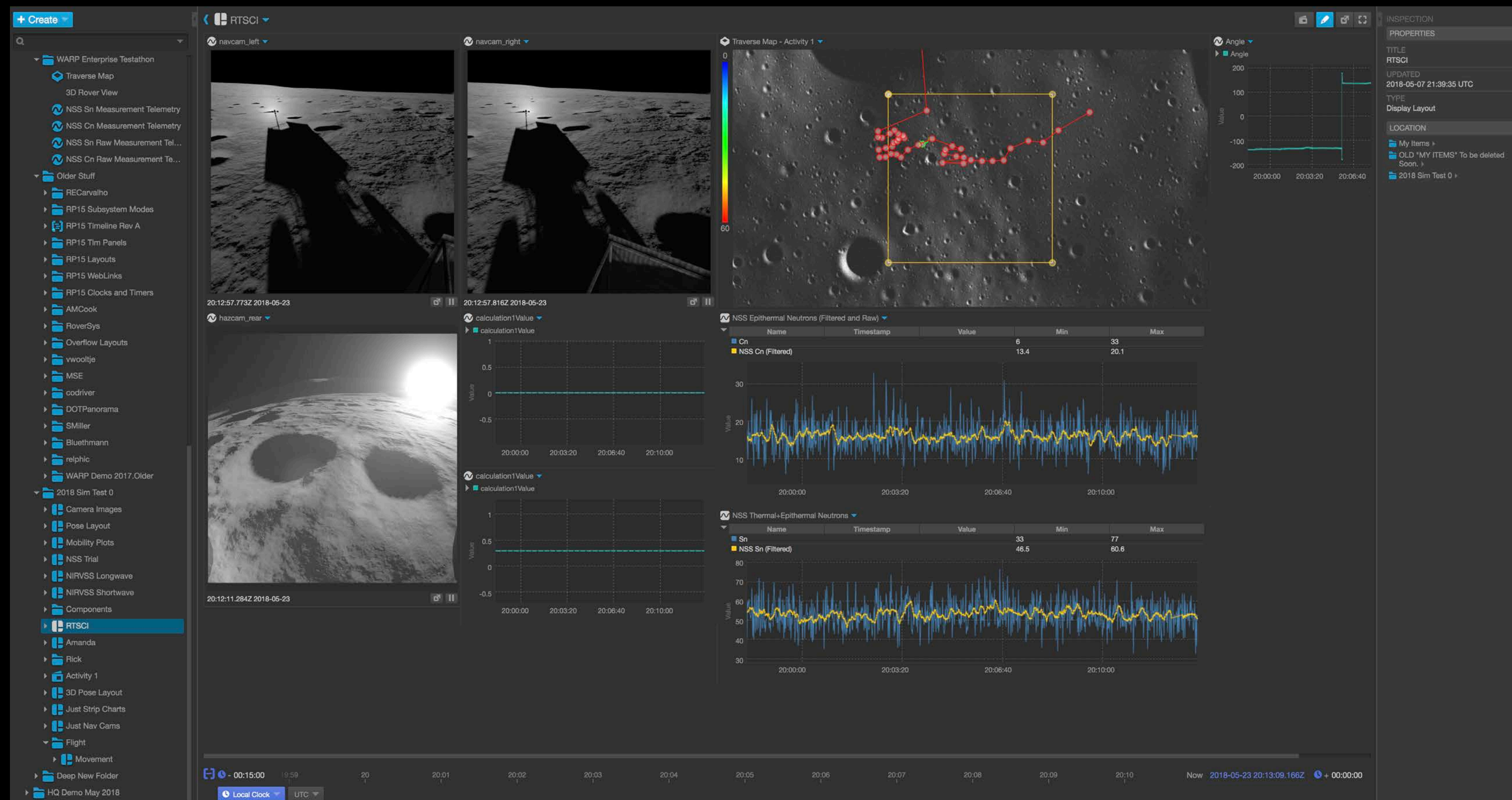


Desktop

<https://github.com/nasa/openmct>



All Your Data in One Place



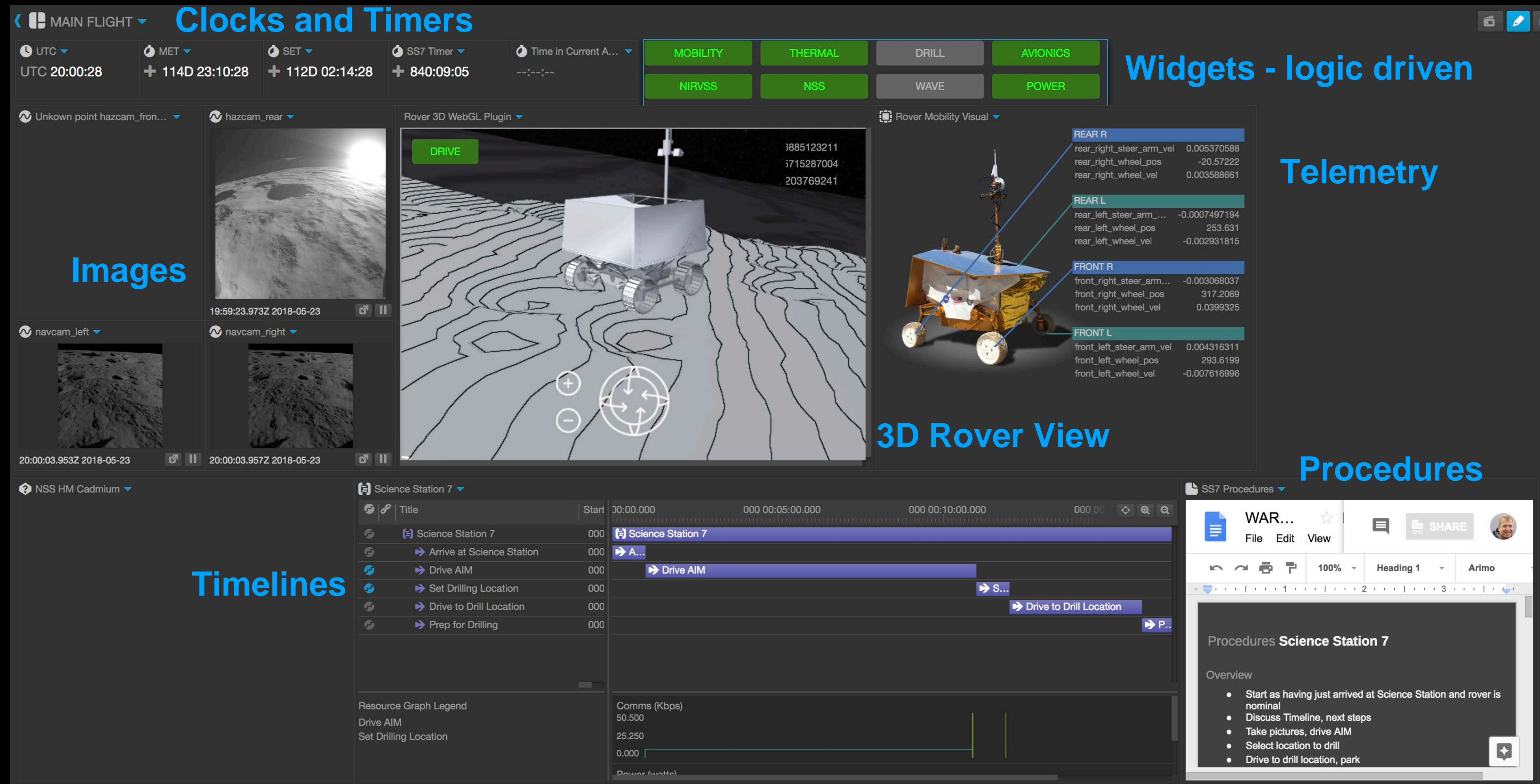
All your
data here

Data Visualizations, cross domain

Inspector



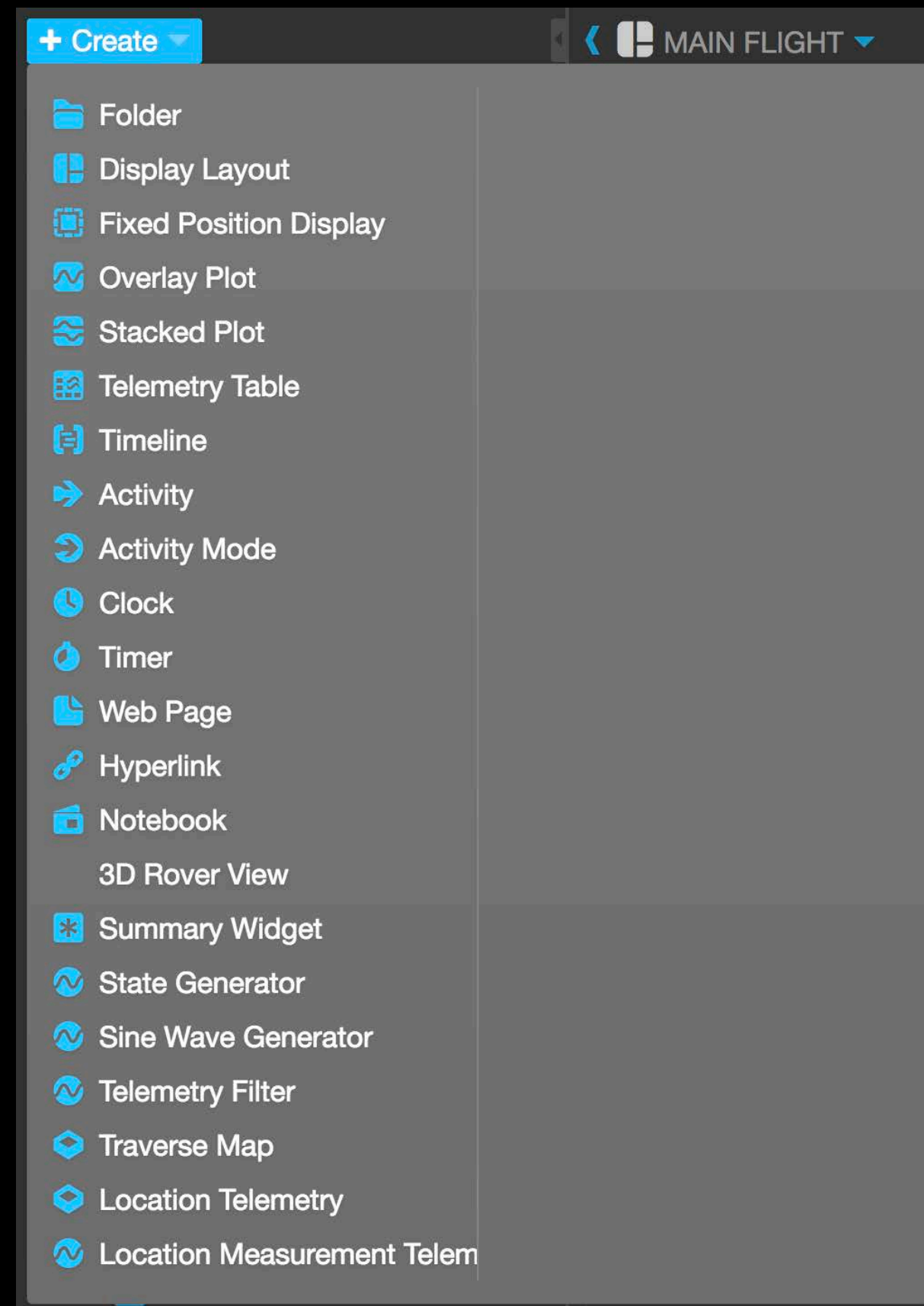
Mix Data Across Domains



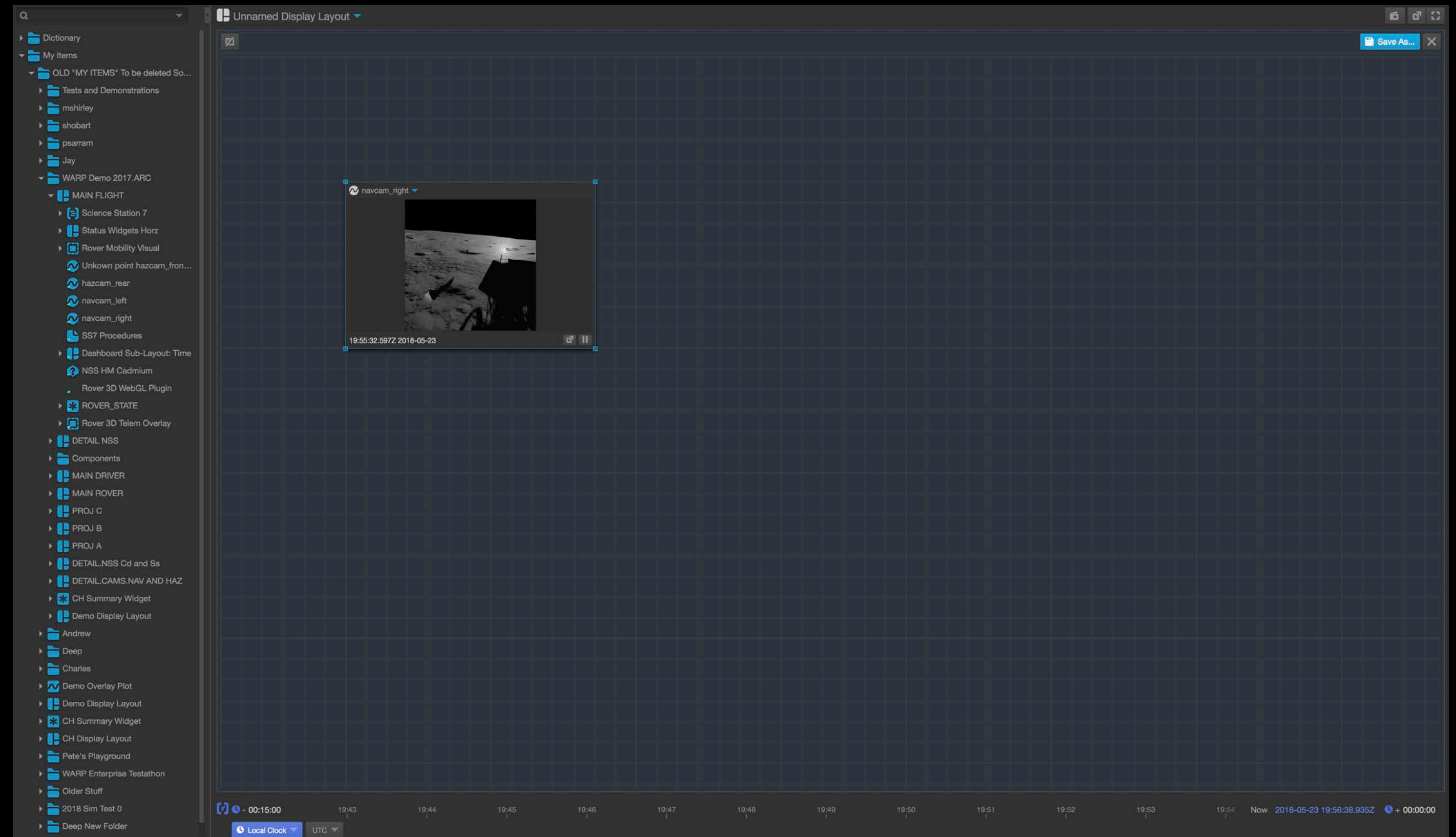
Add capabilities with plugins



Make Your Own Displays



Create



Build a display layout

<https://github.com/nasa/openmct>



Who has Open MCT in NASA



More...

<https://github.com/nasa/openmct>



Open MCT in ESA

- ?



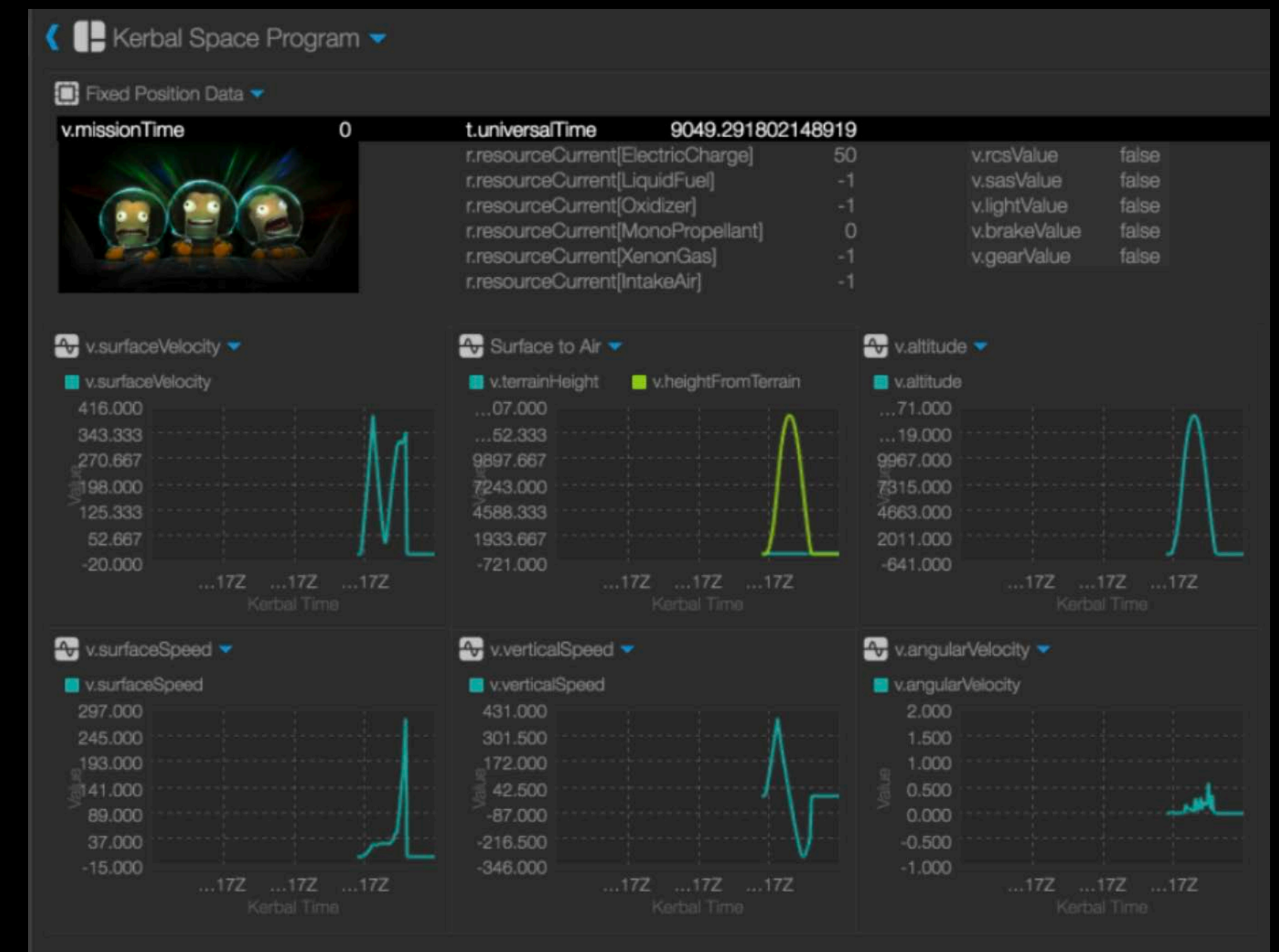
Samples from the community outside NASA

C-base backspace Berlin



<https://bergie.iki.fi/blog/nasa-openmct-iot-dashboard/>

Kerbal Space Program



<https://github.com/nasa/openmct>



Contributors

- 50+ registered contributors, who have submitted:
 - New features
 - Improvements to Documentation
 - Suggestions

<https://github.com/nasa/openmct>



Example Contribution 1

- User of Open MCT found an issue that caused new builds to fail
- They had submitted a PR to fix it before we had even started looking into it

d3 selection filepath changed #1898

Merged akhenry merged 2 commits into `nasa:master` from `thesamprice:d3selectionFix` on Feb 5

Conversation 7 Commits 2 Checks 0 Files changed 2

thesamprice commented on Jan 30 Member +😊 ✎ 💬

d3 changed the location of this file, npm install fails when trying new builds.

d3 selection changed from build to dist. ✖ f087a24

akhenry commented on Jan 31 • edited Member +😊 ⋮

@thesamprice Thanks for pushing this fix!

Hard-coding the paths of node dependencies into our Require configuration is brittle. That's our bad. We need a better strategy here.

I'd like to do a little testing before we merge this because I have seen inconsistencies which possibly relate to node version, npm caching, and various other things. This might be what we're seeing with the CircleCI build.

Stand by! And thanks again!



Example Contribution 2

- Contributor updated all of our copyright statements
- Important tasks, but other priorities meant we hadn't done it yet

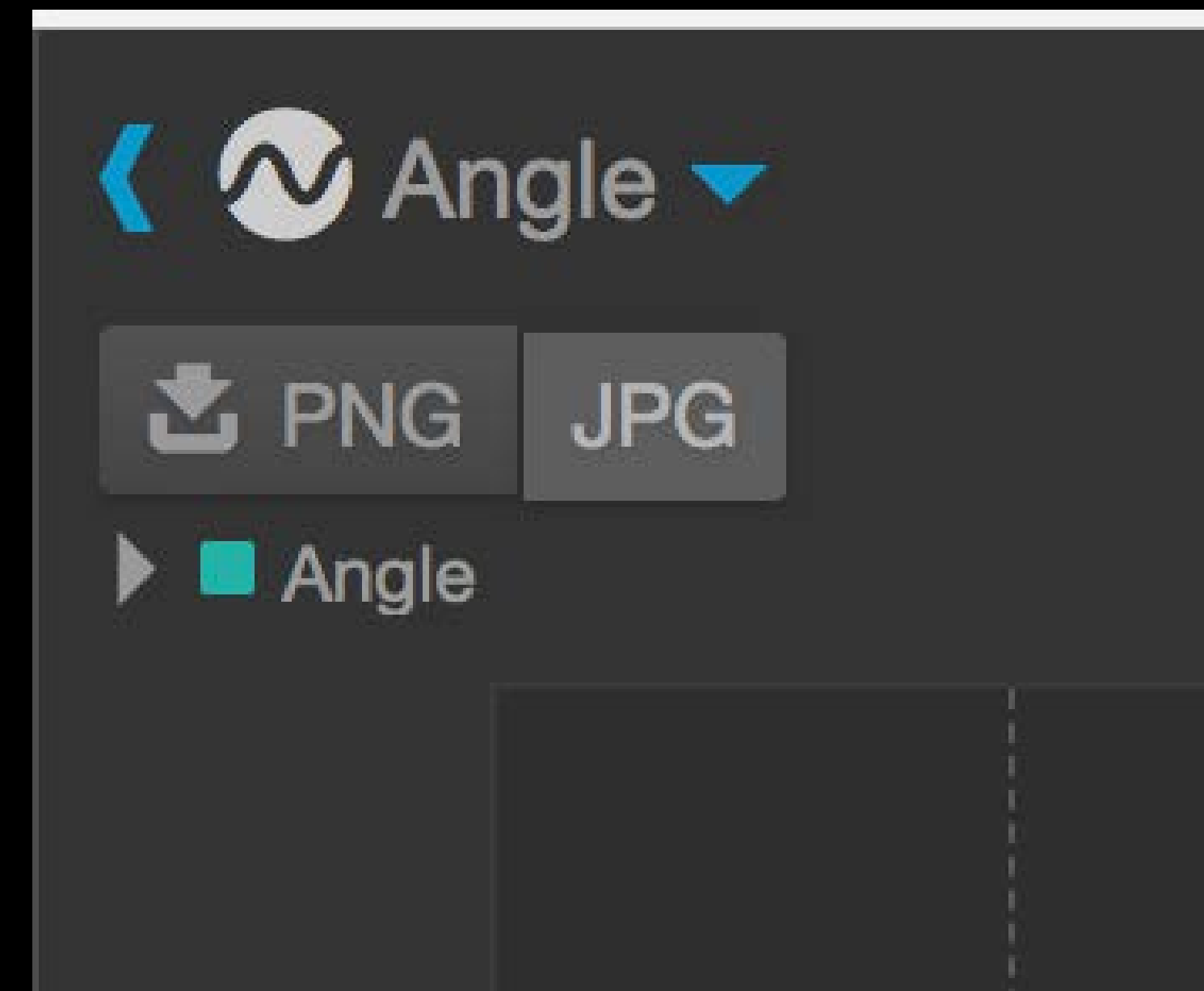
The screenshot shows a GitHub pull request interface. At the top, the title is "Update copyright year across platform code references" with a pull request number "#2035". Below the title, it indicates that "psarram merged 1 commit into nasa:master from PunkChameleon:copyright-year" 9 days ago. A status bar shows "Merged" and statistics: 3 conversations, 1 commit, 0 checks, and 824 files changed, with a net change of +825 lines and -825 lines. The main content area features a comment from "PunkChameleon" 10 days ago, stating "Quick update addressing #2034. All regression tests pass." Below the comment is an "Author Checklist" with four items, all marked as "Y": "Changes address original issue?", "Unit tests included and/or updated with changes?", "Command line build passes?", and "Changes have been smoke-tested?". The commit history shows a commit "Update copyright year across platform code references" by "da81319" with a green checkmark. A review by "psarram" 9 days ago is shown with a "View changes" button. A final comment from "PunkChameleon" says "@PunkChameleon LGTM! Please add the contributor checklist and I'll approve and merge." The right sidebar contains metadata sections: Reviewers (psarram with a green check), Assignees (None yet), Labels (None yet), Projects (None yet), Milestone (None yet), and Notifications.

<https://github.com/nasa/openmct>



Example Contribution 3

- Export plot as image
- Based on user requests
- Implemented by open source contributor





Statistics

- 2015
 - Unknown
- 2018
 - Over 140,000 visitors

GitHub - Favorites	4925
GitHub - Forks	512
GitHub - Watches	224
GitHub - Average Daily Visitors	~80
Website - Page Views	1,214,368
Website - Unique Visitors	148,380
Website - Average Daily Visitors	~100
Signed Contributor License Agreements	51
Code Contributions	34

<https://github.com/nasa/openmct>



Contribution Process

- Sign Contributor License Agreement
- Make changes
- Submit Pull Request (PR)
- Circle CI runs unit tests, enforces code standards through tooling
- Code review by core team member
- Feedback or Merge




Developing Software in the Open

- As well as our software being open source, our process is as well
- Software process documentation available from GitHub repository
- GitHub Projects used as “Kanban” board for each sprint
- All open source bugs and new features tracked as GitHub issues
- Intra-team code reviews via PRs



Building a Community 1

Active Web Presence

**openMCT**

ABOUTGETTING STARTEDCONTRIBUTINGDOCUMENTATIONTRY IT LIVE

Open MCT is a next-generation mission control framework being developed at NASA's Ames Research Center in Silicon Valley, in collaboration with the Jet Propulsion Laboratory.

Web-based, for desktop and mobile.

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HOW IS NASA USING OPEN MCT?

Software based on Open MCT is being used for mission planning and operations in the lead up to the [Resource Prospector mission](#) at NASA's Ames Research Center, and as a data visualization tool at the Jet Propulsion Laboratory.

[FIND OUT MORE](#)

HOW CAN YOU USE OPEN MCT?

Open MCT can be adapted for planning and operations of any system that produces telemetry. While Open MCT is developed to support space missions, its core concepts are not unique to that domain. It can display streaming and historical data, imagery, timelines, procedures, and other data visualizations, all in one place.

[LEARN MORE](#)

HOW TO CONTRIBUTE

We are looking for enthusiastic people who want to help contribute to NASA's exploration of the solar system. Are you a student, professional software developer, or just a space enthusiast? We'd love to hear your ideas for new features or ways of visualizing data. If you're a coder you can help us develop new features or capabilities, and fix bugs.

[GET MORE INFO](#)

Developers: Start Using Open MCT

1 CLONE THE SOURCE CODE

```
git clone https://github.com/nasa/openmct.git
```

2 INSTALL DEVELOPMENT DEPENDENCIES

```
npm install
```

3 RUN A LOCAL DEVELOPMENT SERVER

```
npm start
```

Running and building Open MCT in your local dev environment is very easy. Be sure you have [Git](#) and [Node.js](#) installed, then follow the directions on the left. Need additional information? Check out our [Getting Started](#) page.

<https://nasa.github.io/openmct/>

Active Repository

nasa / openmct

Watch219Star5,026Fork517

CodeIssues284Pull requests22Projects1Insights

Join GitHub today

GitHub is home to over 20 million developers working together to host and review code, manage projects, and build software together.

[Sign up](#)

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Branch: masterNew pull requestFind fileClone or download

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API.md	Summary widget telemetry provider (#1943)	a month ago
CONTRIBUTING.md	[Documentation] Edit for style	a year ago
LICENSES.md	Include 2017 in copyright #1517	a year ago
Procfile	Merging in latest github/master	3 years ago
README.md	prepare -> prepublish	5 months ago
app.js	Revert "[proxyUrl] pass URL parameters to proxied URL"	2 years ago
bower.json	Lock filesaver version (#1956)	2 months ago
build-docs.sh	[Licenses] Update copyright year to 2017	a year ago
circle.yml	Bump Node Version	23 days ago
gulpfile.js	adds v8-compile-cache	5 months ago
index.html	[Autoflow] Rewrite Autoflow Tabular using new APIs (#1816)	6 months ago

<https://github.com/nasa/openmct>

<https://github.com/nasa/openmct>



Building a Community 2

- Provide a codebase that is clean, and fun to develop for
- Provide clear and comprehensive developer documentation
- Provide a simple and powerful Application Programming Interface (API)
- Tutorials for extending Open MCT with a focus on common use-cases.
- “Help-wanted” issues that cater to a range of abilities

The screenshot shows the GitHub repository page for `nasa/openmct`. The repository has 219 watchers, 5,026 stars, and 517 forks. The 'Issues' tab is selected, showing 284 issues. A search filter is applied: `is:open label:"help wanted"`. The list of issues includes:

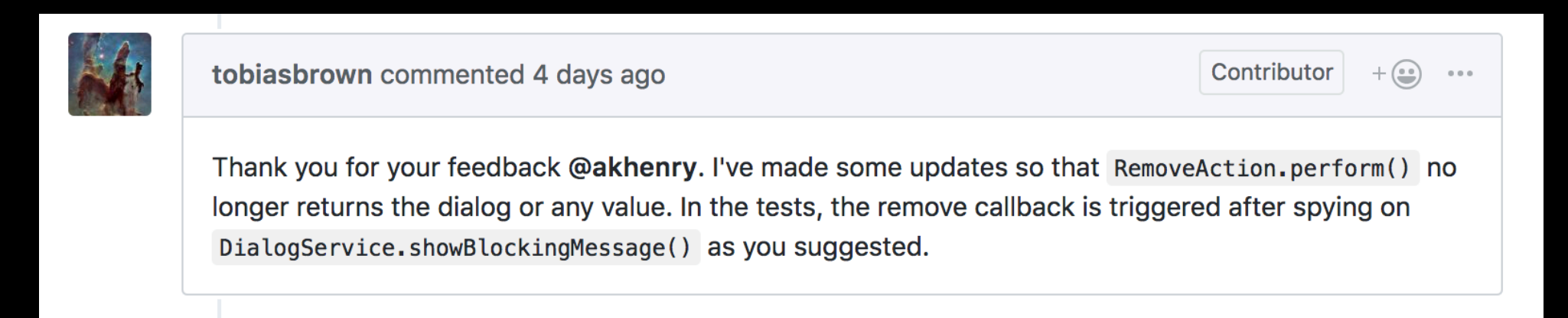
- [Imagery] Duplicate image showing in history** (help wanted) - #2012 opened 22 days ago by dtailor90
- [Tables] Add clear filter button to Table View column filters** (help wanted) - #1989 opened on Apr 11 by charlesh88
- [Build] Unknown/unknown appear in About dialog** (help wanted) - #1924 opened on Feb 22 by vicfx
- [Tree] Drop down arrow remains even though object has no children** (bug, help wanted) - #1826 opened on Dec 5, 2017 by dtailor90
- support bignum for number types not representable with float64** (help wanted) - #1788 opened on Oct 25, 2017 by larkin
- disable spellcheck on date fields** (help wanted) - #1682 opened on Aug 18, 2017 by larkin
- Add telemetry plugin for DSN station telemetry and status** (enhancement, help wanted) - #1656 opened on Jul 25, 2017 by larkin
- Remove action is available for non-editable objects** (bug, help wanted) - #1542 opened on Apr 26, 2017 by akhenry
- [search] Provide a way to disable ElasticSearch from affecting Search** (help wanted) - #1399 opened on Jan 12, 2017 by charlesh88
- [Fixed Position, Layouts] Better default sizing for new objects in Fixed Position views** - #1399 opened on Jan 12, 2017 by charlesh88

<https://github.com/nasa/openmct>




Supporting a Community

- Be responsive to comments and questions from the community
- Friendly, supportive environment with constructive developer feedback
- Dedicate the time to support the community

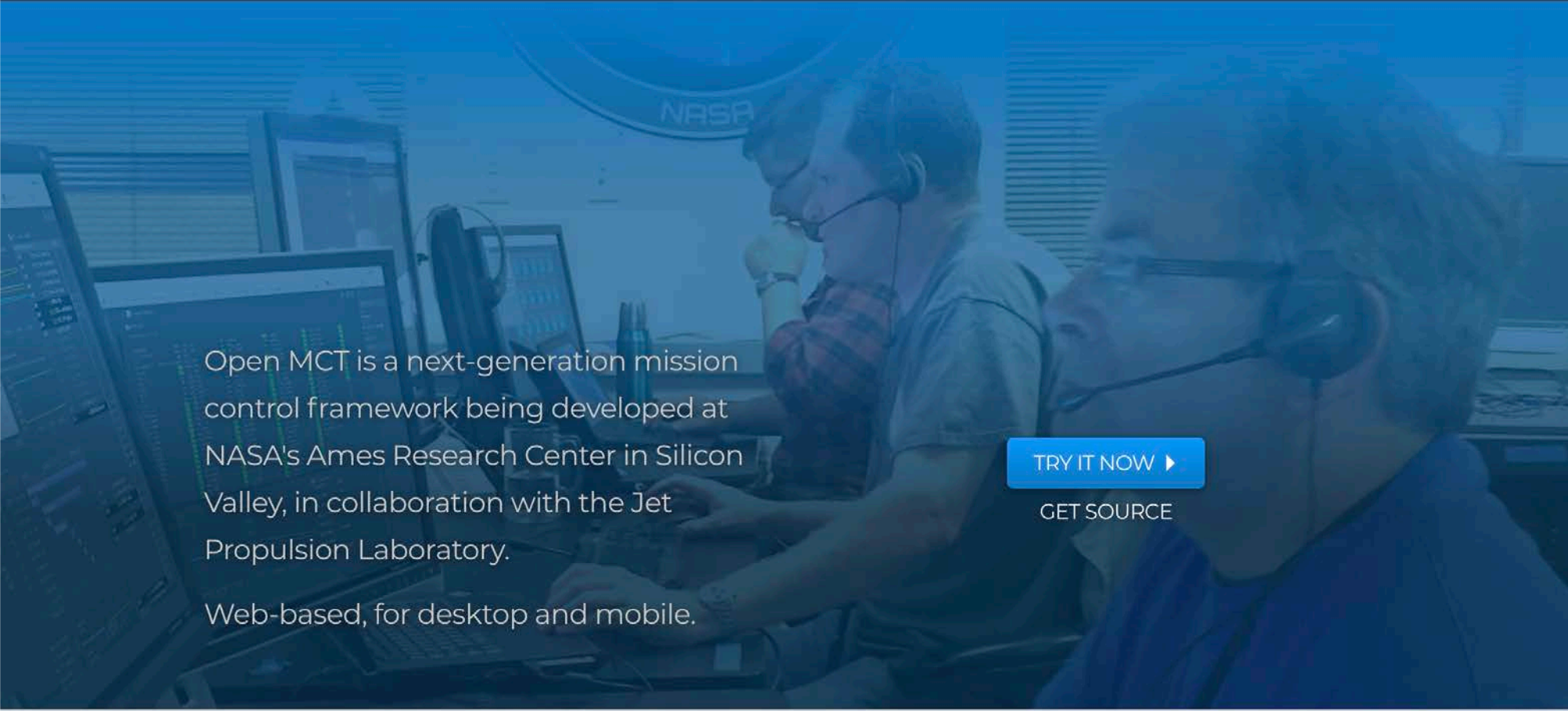




Try it

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GET MORE INFO ▶



+ Create

Q

Demo Objects

▶ Mars Weather Display Lay...

▶ Planning

▶ **Rover Operator Layout**

▶ Example Rover

▶ Mars Science Laboratory

▶ My Items


UTC

UTC 2018/05/25 16:28:47

Mission Elapsed Time

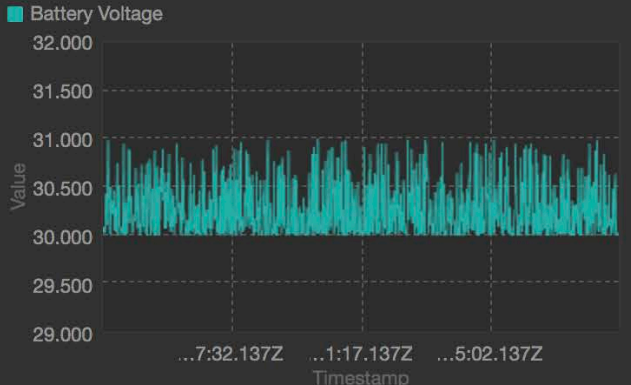
431D 23:32:22

Rover Navcam 1



16:28:40.000Z 2018-05-25

Battery Voltage

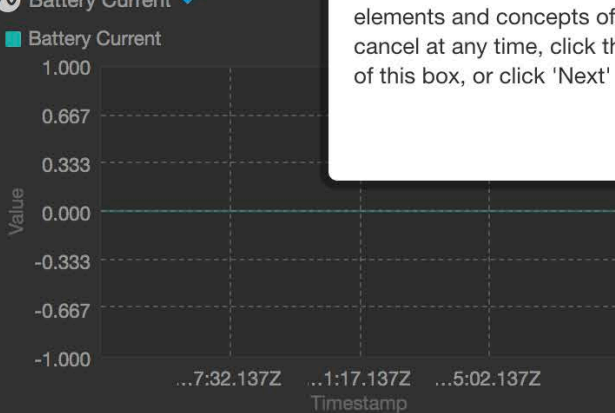


Rover Surface Operations

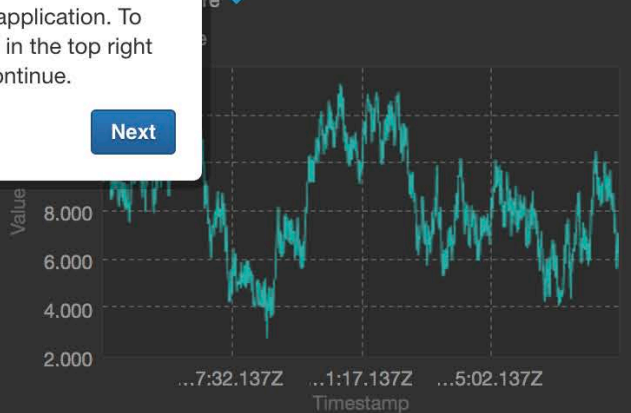
Title	Start	
Rover Surface Operations	000 00:00:00	
▶ Post-landing shakedown	000 00:00:00	▶ Post-landing shakedown
▶ Lander Egress	000 02:00:00	▶ Lander Egress
▶ Driving	000 03:00:00	▶ Driving
▶ Drilling	000 03:35:20	▶ Drilling

Resource Graph Legend

Battery Current



Battery Voltage



INSPECTION

PROPERTIES

TITLE

Rover Operator Layout

UPDATED

2017-03-19 17:14:20 UTC

TYPE

Display Layout

LOCATION

Demo Objects ▶

Welcome to Open MCT

This brief tour will introduce you to the main elements and concepts of the application. To cancel at any time, click the 'x' in the top right of this box, or click 'Next' to continue.

Next

<https://nasa.github.io/openmct/>

On Line Demo



Lessons Learned

- Supporting Open Source requires time
- Our code contributions have been of high quality on the whole
- Once a project is open-source and online you do not control the profile of the project. Someone submitted us to Reddit and we hit 20,000 visitors a day
- Substantial code contributions are made by a small number of contributors, who tend to make multiple contributions
- Help contributors to help you - documentation, tutorials
- Still a lot of work to do to improve our API, but we're making progress

<https://github.com/nasa/openmct>



Status & What's Next

- Open source is a proven means to enhance collaboration and adoption of mission operations software
- It is possible to build an “outside” community of contributors who add value to the software through contributions and feedback
- Future goals
 - Build an active community of mission contributors building on each other's work
 - Use open source as a vehicle for advancing technology